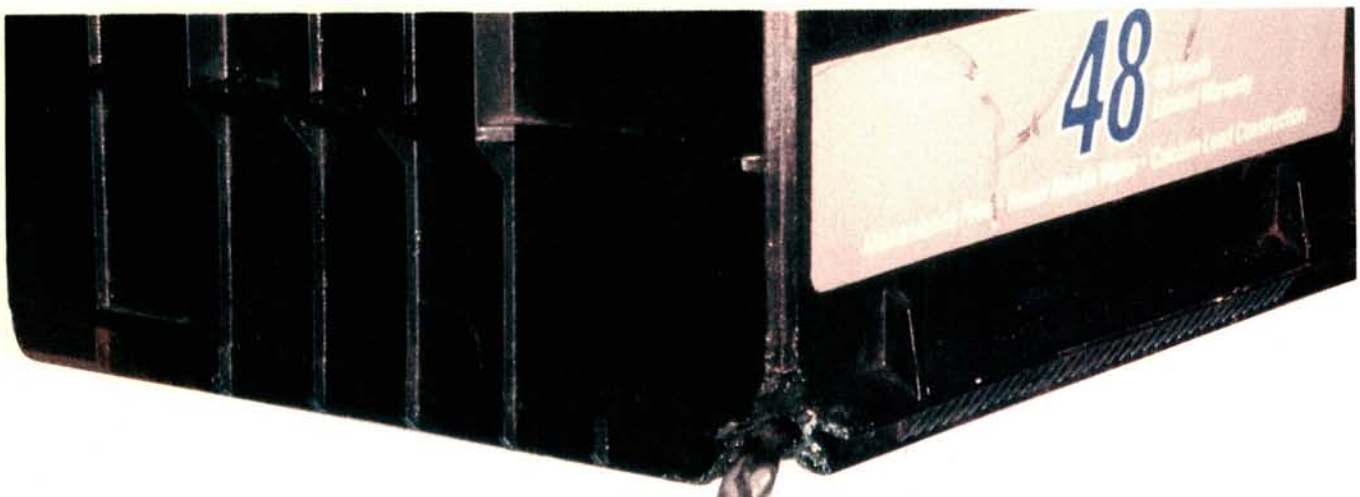


Key Off Battery Drain

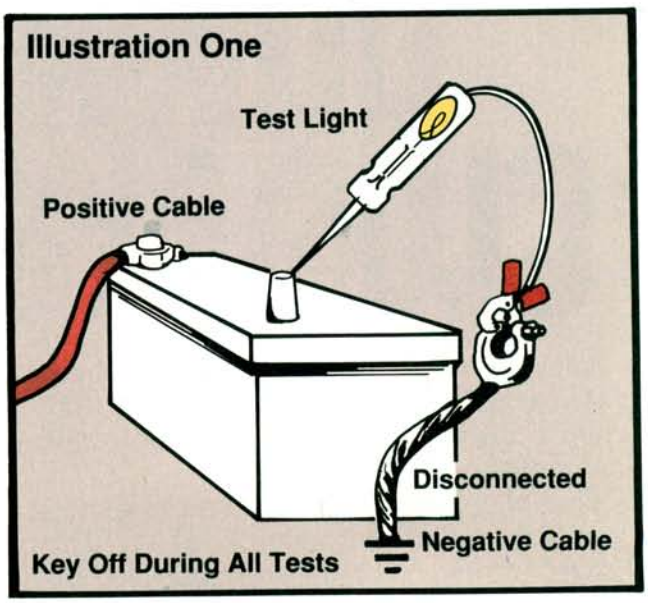
Your customer parked his car at the airport for a few days while he traveled on business. When he returned, he was greeted by a dead battery. A tow truck brought the car and one unhappy customer to your shop. After properly charging and testing the battery, you've eliminated it as the source of the problem. The alternator charging rate also looks good. So what caused the dead battery?

Key off battery drain! We touched briefly on testing for key off battery drain using a DVOM on page 9 of the "Good Connections" article in the August 1990 issue of *Import Service*. The increasing use of electronics and computer memories means that key off battery drain is probably here to stay. But how much key off battery drain is normal, and how much will run the battery flat when the car isn't driven for a few days?

There are several ways to check for key off battery drain. Some are good, some are not so good, and some are downright hazardous to the health of your DVOM. We'll run through the different methods, briefly explain their advantages and drawbacks, then demonstrate the safest and most effective method for measuring key off battery drain.

Quick and Dirty

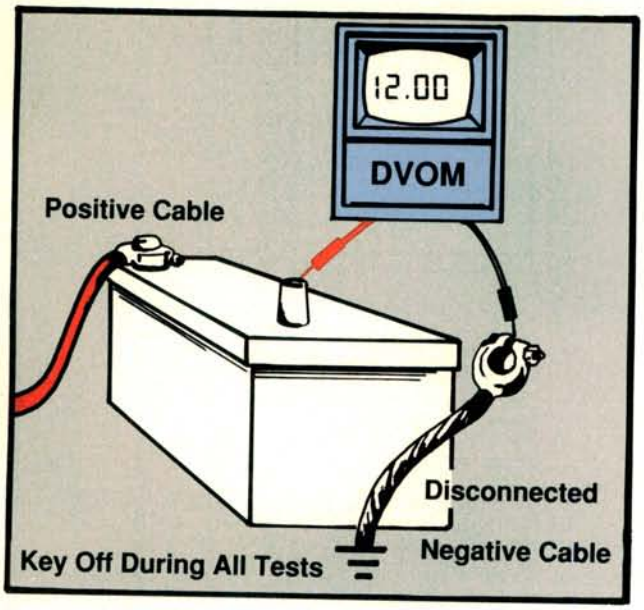
Probably the least expensive, but also the crudest method of checking for a key off battery drain is to place a test light in series between a battery post and its corresponding battery cable. The brightness of the test light's bulb is used to determine the amount of key off battery drain. The brighter the bulb, the bigger the key off battery drain. Obviously this isn't a very accurate system. After all, how bright is too bright?



Another old time method was to place a voltmeter in series with the same battery terminal and cable we used for the test light. This method worked pretty well when we were still using analog voltmeters that had 1000 ohms per volt input impedances. The voltmeter would read about six volts if there was a key off drain problem.

The problem with using this method today is that we've switched to DVOMs for most of our electrical measurements. Almost all DVOMs now have a 10 megohm input impedance. These meters will read a full 12 volts when connected in series between a battery cable and post, even when key off battery drain is at a normal level. Taking a reading this way isn't going to tell us what we need to know.

Illustration Two

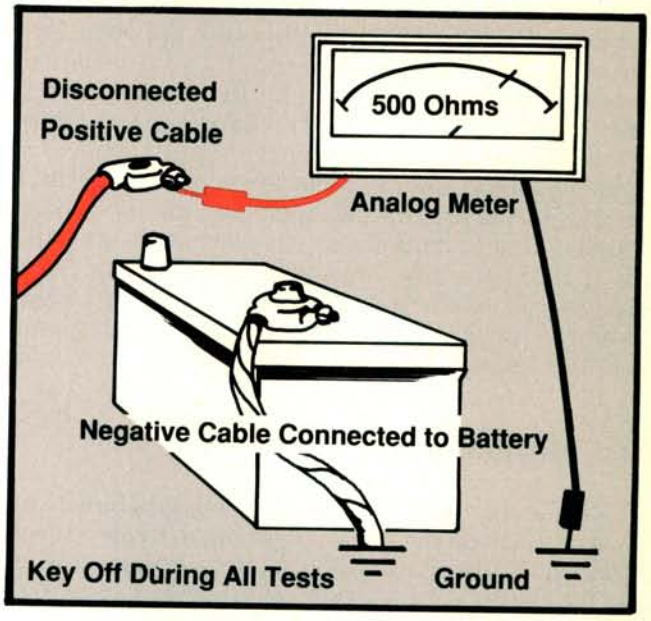


Pencil and Paper

If you still have an analog multimeter, you can use it along with Ohm's Law (also covered in the August 1990 *Import Service*) to determine the amount of key off battery drain. Disconnect the positive battery cable, then attach one of your analog ohmmeter leads to the positive cable and the other to ground. The resulting ohm reading tells you the total resistance of the car's electrical system with the key off.

Let's say your analog meter shows a total electrical system resistance reading of 500 ohms. We know that normal key off battery voltage should be 12.6 volts. If we plug both of these numbers into the Ohm's Law equation, we can determine the amount of key off battery drain measured in amps.

Illustration Three



Dividing the battery's 12.6 volts by the electrical system's 500 ohms of resistance tells us that the key off battery drain is 0.0252 amps (or 25.2 milliamps). This key off battery drain is too small to cause any problems.

But what if our ohm reading in this test was 100 ohms instead of 500? Dividing 12.6 volts by 100 ohms gives us .126 amps (126 milliamps). We're probably looking at a dead battery in the making. Something in the electrical system is providing an easy path for electrons to march out of the positive battery terminal and head for ground.

As good as this method is for finding key off battery drain, it still has one drawback. It's really a static test because very little voltage is actually flowing through the electrical system during the test. So even if you use an analog meter as we've instructed, you still might miss the source of the key off drain.

Here's why. The analog meter only sends about 1.5 volts through the electrical system during the ohmmeter test. Some defective solid state circuits won't break down unless they are connected to their normal key off battery voltage of 12.6 volts. The 1.5 volts the ohmmeter puts through the electrical system might not be enough to make them act up.

Getting Warmer

We demonstrated a fourth method in the "Good Connections" article. This method will work fine, as long as you observe certain precautions. The DVOM is still installed in series with the battery terminal and cable. But the DVOM's ammeter circuit, not its voltmeter circuit, is used to measure the key off battery drain. The actual amount of battery drain flows directly through the series-mounted meter, and is displayed in amps on the meter.

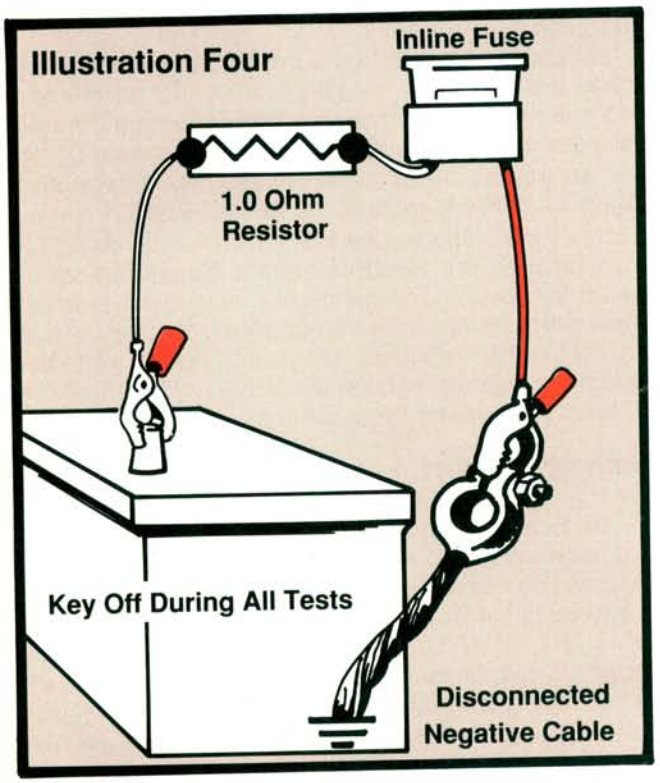
Unfortunately, you might end up "smoking" your DVOM if you aren't careful. We warned you about this danger and reminded you not to crank the engine or operate any accessories while the DVOM is installed in series during key off drain testing. There's also a chance that your meter could be damaged if the battery has been recently recharged.

Some meters are fuse protected to prevent internal damage during amp testing, others are not. Some have a higher amp scale that you can start out with until you find out just how large the battery drain is. After that, you can switch to a more sensitive milliamp scale. This will protect your meter from over ranging and possible damage.

Best Method of All

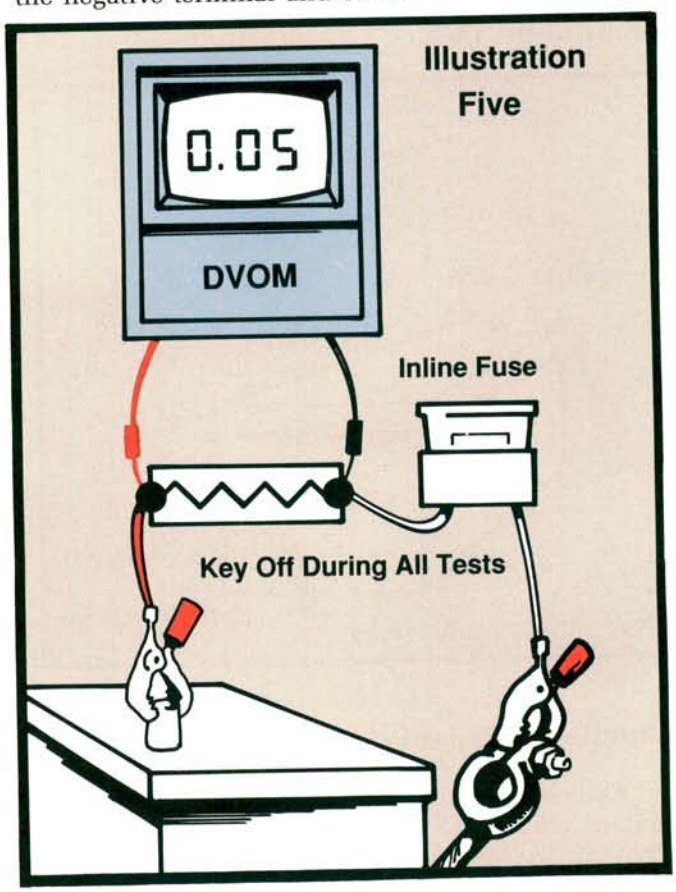
Rather than run the risk of having a bunch of melted meters on our consciences, we thought we had better show you the safest and most accurate way to test for key off battery drain. All it takes is a trip to your local electronics supply house and a few minutes spent with a soldering iron.

Unlike the static ohmmeter test we described earlier, a dynamic test for key off drain will catch voltage sensitive circuits that only break down under normal operating voltage. With a dynamic test, the key off drain is checked with the full 12.6 battery volts applied to the whole electrical system. This will stress any defective solid state circuits, and should cause the resulting high key off battery drain to show up.



You'll need to buy an extra set of test leads for your DVOM, a 1.0 ohm/10 watt resistor, and an in-line fuse holder. Cut the positive test lead near the test probe, then solder the in-line fuse holder in place. Now solder the resistor between the test leads as shown. Protect the solder joints with tape or shrink wrap tubing. The resistor can even be enclosed in a small project case if you want to get fancy.

Remove the negative battery cable, then hook up your DVOM and test leads as shown in Illustration 5. Many of you may be accustomed to checking for key off battery drain using the positive battery terminal and cable. Several manufacturers warn that under certain circumstances you run the risk of deploying the air bag if you make your key off battery drain tests on the positive side of the battery. Play it safe and always use the negative terminal and cable.



We're showing 0.05 volts on our voltmeter in this example. We'll use Ohm's Law to figure the actual amount of key off battery drain, measured in amps. Multiply the 0.05 volt reading by 1.0 ohm (the voltage drop across our 1.0 ohm resistor). Now we know that key off battery drain is 0.05 amps, or 50 milliamps.

Permanently soldering the 1.0 ohm resistor into our test leads lets us skip the Ohm's Law calculations when we want to figure key off battery drain. The voltage reading is always going to be the same as the actual key off battery drain, measured in amps. You can put your pencil and paper aside.

Tracking Down The Drain

To find the cause of an excessive key off battery drain, remove the fuses from the fuse block one at a time. Watch your voltmeter carefully. When it drops back to the normal key off battery drain reading, you've found the source of your extra battery drain.

Now consult the vehicle wiring diagram or power distribution schematic. This will tell you which circuits are powered through the fuse you've just removed. Disconnect individual circuits that are supplied by the fuse until you find the source of the battery drain. Key off battery drain will drop back to normal when you find the culprit. Repair the circuit or electrical component, then reinstall the fuse to check your work.

If pulling all of the fuses doesn't eliminate the battery drain, the drain may be coming from a circuit that's protected by one of the vehicle's fusible links. Check the power distribution schematic again, then begin disconnecting fusible links one at a time. When the key off battery drain drops back to normal, test the individual circuits that are protected by the fusible link until you find the problem.

How Much Is Too Much?

While it's hard to say what an acceptable key off battery drain should be, 100 milliamps seems to be a good cutoff point. Problems often develop when key off battery drain exceeds this number.

Some manufacturers are beginning to publish normal key off battery drain specifications. Computer memories and other accessories need a small amount of key off battery power to function properly. There are also some cars that normally exceed a 100 milliamp key off battery drain. It wouldn't do much good to try to repair an electrical system that's *supposed* to draw over 100 milliamps. Check the vehicle specifications (if available) before you start. If they aren't available, let your own experience with similar models be your guide.

If a vehicle's key off drain is supposed to run on the high side, or if the owner has added accessories that will increase it, make sure the battery has the highest reserve capacity available. A battery with a low reserve capacity will have a shortened life span if it's installed in a car that normally has a high key off battery drain, especially if the car isn't driven for long periods.

—By Karl Seyfert